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Bureau of Entomology and Plant Quarantine

A SYSTEM OF CLASSIFYING CABBAGE ACCORDING TO THE EXTENT
OF CATERPILLAR INJURY

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During the course of investigations on the control of certain species of cabbage caterpillars in the Charleston, S. C., area during the period 1935-39 a system of classifying the cabbages at harvest time as to their market qualities and the degree of insect injury was devised. A discussion of this system follows.

General Considerations

It was recognized at the outset that any classification system devised should be based on accepted market standards, that only caterpillar injury visible at harvest or known effects of earlier injury could be considered, and that in the use of the classification there would be variations that resulted from differences in the personal judgment of different graders. It also was recognized that there are differences in the requirements of various markets.

According to the U. S. Standards for Cabbage issued by the Agricultural Marketing Service, U. S. Department of Agriculture, cabbage is classified as U. S. No. 1, U. S. Commercial, and Unclassified. The term Unclassified is not a grade name but is provided as a description to show that no definite grade has been applied to the lot. The U. S. No. 1 grade requires the cabbage to be free from damage by worm injury. The U. S. Commercial grade is the same as U. S. No. 1 grade except for an increased tolerance for defects.

¹ In cooperation with the South Carolina Agricultural Experiment Station. Credit is due C. F. Stahl, C. E. Smith, C. O. Bare, and L. B. Reed for their contributions in the development of this classification of cabbage, and to Mr. Bare for his assistance in obtaining the photographs.

It should be noted that there is a distinction between the terms "damage" and "injury" as used in the U. S. Standards for Cabbage and in this paper. Damage refers to caterpillar injury which is of such a nature or extent as to cause a plant to be ineligible to the U. S. No. 1 grade. Probably the most important factor involved in the classification described herein is the matter of deciding just when caterpillar injury or injuries should be considered as damage. For use as a guide in this work, photographs were secured of heads which a licensed inspector of the Department of Agriculture passed for No. 1 grade and also those which failed to grade U. S. No. 1 because they were damaged by worm injury. In the case of the studies for which this classification was designed, advice as to grading procedure was obtained by the author from Messrs. Robert Bier, Supervising Inspector of the Agricultural Marketing Service of the U. S. Department of Agriculture, T. A. Cole, Agent in Marketing of the South Carolina Agricultural Extension Staff, and J. F. Jones, then Assistant Agricultural Agent of Charleston County, S. C. Plants graded by Mr. Cole were photographed.

Among other requirements for the U. S. No. 1 grade there must be not more than four loose outer or wrapper leaves, unless the crop is to be sold under the subgrade "U. S. No. 1 Green", which permits as many as seven wrapper leaves. The classification described herein is based on the appearance of the firm head and four wrapper leaves, with suitable classes provided for those plants which do not produce such a head. In order to provide fair comparisons of the various experimental control treatments as to numbers of plants, the classification does not permit the stripping of outer leaves to less than four. Stripping of the outer leaves to less than this number in order to eliminate insect injury is sometimes done in commercial practice, but such a procedure is not considered desirable in experimental work.

In commercial grading, any single container of cabbage of a particular grade may contain a certain maximum percentage, by weight, of heads not meeting the requirements of the grade. This tolerance factor was given consideration in designing the classification described herein, but it was decided that it would be desirable in experimental work to grade each plant upon its individual merits, to place it in a class consisting only of plants of similar quality, and to disregard the tolerance allowance. Insect damage is only one of the several defects that cause cabbage to be ineligible to the U. S. No. 1 grade, and the proportion of insect damage to the other defects varies greatly in different plantings. The assignment of any portion of the tolerance to insect damage would have to be done on a rather arbitrary basis. Inasmuch as the tolerance is designed to allow for variations incident to proper grading, it might be considered in this connection that a large proportion of the variation that occurred in the

grading operations formed a part of the experimental error that was calculated for each experiment and used as a basis for comparing the various treatments thereof.

The Classification

- Class 1. Plants whose firm head and four wrapper leaves are free of visible caterpillar injury, and in other respects are eligible to U. S. No. 1 grade (fig. 1, upper).
- Class 2. Plants whose firm head and four wrapper leaves show caterpillar injury not classed as damage, and in other respects are eligible to U. S. No. 1 grade (fig. 1, lower).
- Class 3. Plants not eligible to U. S. No. 1 grade as a result of caterpillar damage:
- a. Those having firm heads (fig. 2).
 - b. Those not having firm heads because of caterpillar feeding (fig. 3).
- Class 4. Plants from which U. S. No. 1 grade cabbage cannot be obtained because of defects other than caterpillar damage (fig. 4).

Some Uses of the Classification

The use of the classification in the interpretation of results of cabbage-caterpillar studies will be rather obvious from the nature of the various classes that are described. However, it might be well to state that class 1 represents an extra-fancy-quality product; the plants of class 2 are those that are combined with class 1 to indicate the production of U. S. No. 1 grade plants; the yield losses due to caterpillar damage are indicated by the class 3 plants; and class 4 consists of those plants which did not produce marketable heads because of disease, hereditary characteristics, or the results of unfavorable weather or soil conditions.

At the time this classification was devised, the U. S. No. 1 grade was the only market grade for cabbage that provided for the marketing of the crop according to uniform standards. Consequently that grade was used as a basis for the classification even though it was realized that in the commercial marketing of cabbage much of the crop is sold without being graded. In the studies for which this classification was designed plants of classes 1 and 2 constituted what were termed marketable cabbage. In actual practice, however, these can be sold as U. S. No. 1 grade even though they include the amount of damaged cabbage allowed by the tolerance. The revised U. S. Standards for cabbage effective December 20, 1939, provide for the sale of cabbage as U. S.

Commercial Grade even though as much as 25 percent is damaged. In this connection, however, it should be remembered that caterpillar damage is not the only defect that cabbage may have and that a certain portion of these tolerances may have been already used as a result of the experimenter's errors in grading.

The separation of class 3 plants into subclasses 3a and 3b permits an indication as to the time and extent of the caterpillar infestation which caused the plant to be considered damaged. Subclass 3a plants are those that formed firm heads and were damaged after the plant began heading and possibly by what might be termed a moderately heavy infestation, whereas the plants of subclass 3b are those whose buds were destroyed during the early stage of the development of the plant or they are those plants that encountered a severe infestation after heading began and consequently did not form firm heads.

The classification as used served as a uniform means of evaluating the caterpillar injury occurring in the various individual fields and seasons involved in the survey studies, as well as for comparing the effects of the different treatments in the control experiments.

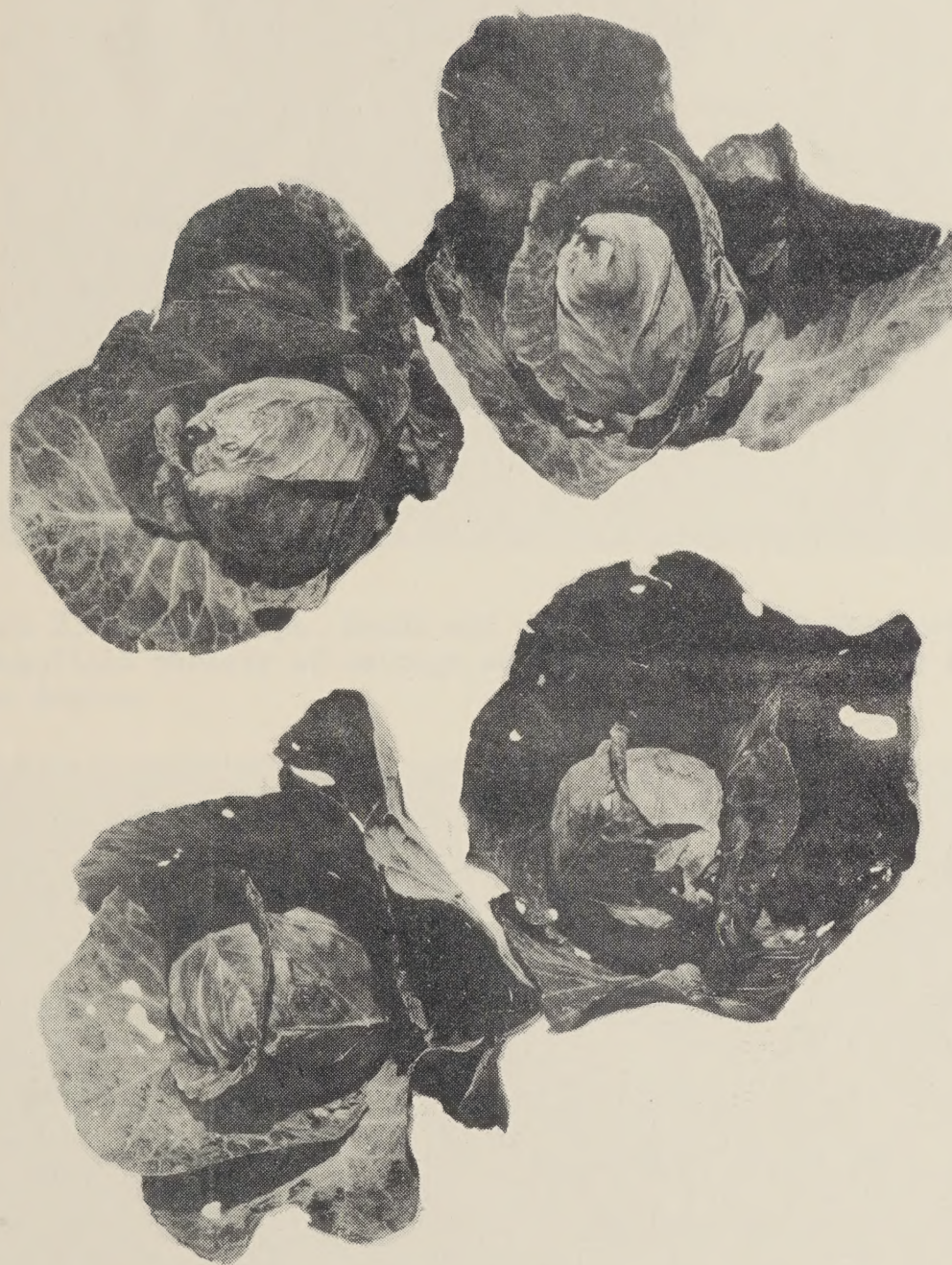


Figure 1.--Upper: Typical Class 1, heads and wrapper leaves of the Charleston Wakefield variety of cabbage without visible caterpillar injury, and in other respects eligible to U. S. No. 1 grade. Lower: Typical Class 2, heads with visible caterpillar injury but not classed as damage, and in other respects eligible to U. S. No. 1 grade.

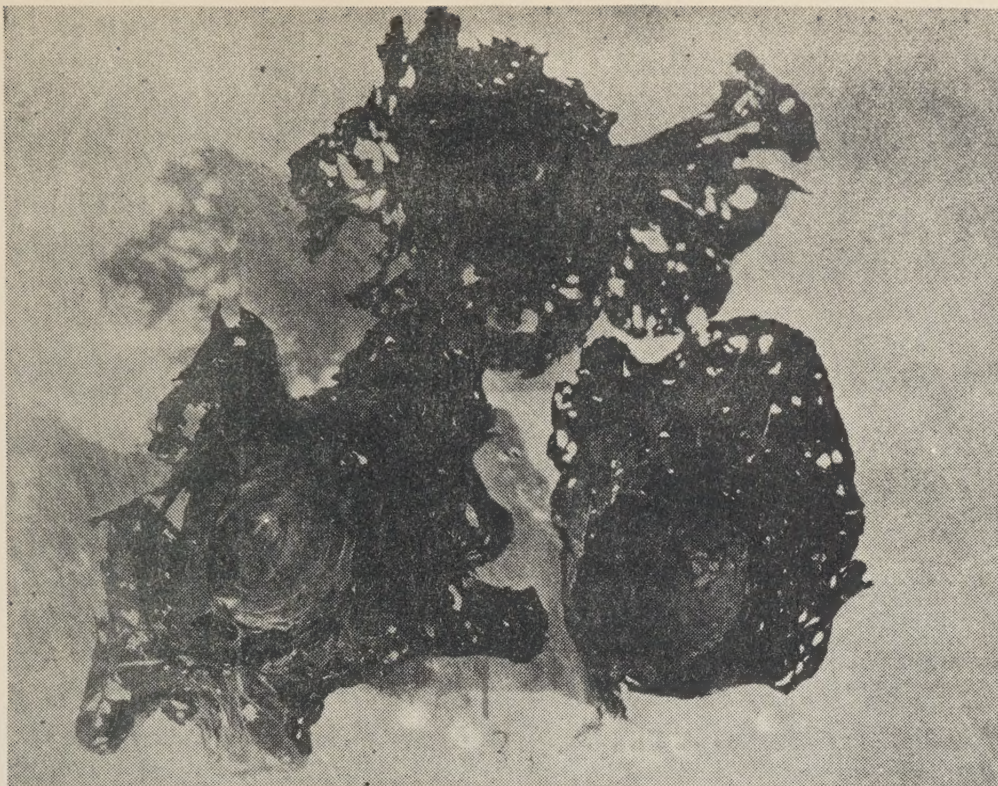


Figure 2.--Subclass 3a, heads and wrapper leaves of Charleston Wakefield variety of cabbage showing caterpillar injury classed as damage.



Figure 3.--Subclass 3b, plants of Charleston Wakefield variety of cabbage damaged by caterpillars to the extent that marketable heads were not produced.



Figure 4.--Class 4, plants of Charleston Wakefield variety of cabbage which did not produce marketable heads because of defects other than caterpillar damage.

